CLAIMS

1.   A method for stabilizing motion in a sequence of frames,

comprising:

        identifying one or more features in a first frame in the sequence of frames;

5   calculating tracked positions for one or more features in each other frame in

the sequence of frames based on the features in the first frame;

        calculating ideal positions for the features in each other frame in the

sequence of frames based on the tracked positions;

        identifying transformation information based on the tracked positions and

10   the calculated positions; and

        transforming each other frame in the sequence of frames by adjusting pixels

in each other frame based on the transformation information.

2.   The method of claim 1, further comprising:

        determining whether the sequence of frames was recorded with fast camera

15   motion or slow camera motion.

3.   The method of claim 2, further comprising:

        when it is determined that the sequence of frames was recorded with fast

camera motion, performing matching to calculate tracked positions for each feature

in a second frame in the sequence of frames.

20   4.   The method of claim 3, wherein matching further comprises:

        identifying one or more features in the second frame; and

matching the one or more features in the first frame to the one or more features in the second frame.

5.   The method of claim 2, further comprising:

when it is determined that the sequence of frames was recorded with slow camera motion, performing global tracking to calculate estimated positions for each of the one or more features in the second frame.

6.   The method of claim 5, wherein global tracking further comprises:

selecting a first feature in the first frame; and

searching a portion of the second frame to find a feature that corresponds to the selected first feature in the first frame.

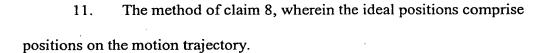7.   The method of claim 1, wherein calculating tracked positions further comprises:

performing local tracking.

8.   The method of claim 1, wherein calculating ideal positions further comprises:

plotting the tracked positions in an X, Y coordinate graph; and

drawing a motion trajectory by connecting a first one of the plotted tracked positions with a last one of the plotted tracked positions.

9.   The method of claim 8, wherein the motion trajectory is linear.

10.   The method of claim 8, wherein the motion trajectory is non-linear.

11.   The method of claim 8, wherein the ideal positions comprise positions on the motion trajectory.

12.   The method of claim 11, wherein an ideal position for a point of interest has a same X-coordinate and a different Y-coordinate as compared to a tracked position for the point of interest.

13.   The method of claim 1, wherein transformation information comprises rotation, scaling, shearing, and/or translation information for each pixel of each other frame in the sequence of frames.

14.   The method of claim 13, wherein transforming each other frame further comprises:

adjusting each pixel in each other frame based on the rotation, scaling, shearing, and/or translation information.

15.   The method of claim 1, wherein transforming each other frame in the sequence of frames further comprises:

performing affine transformation using the tracked positions and the ideal positions.

16.   The method of claim 15, wherein performing affine transformation further comprises:

determining values of coefficients representing rotation, scaling, shearing, and/or translation information using the tracked positions and the ideal positions.

17.   The method of claim 16, further comprising:

applying the values of the coefficients to each pixel of the first frame to

obtain positions of each pixel in a second frame.

18.   The method of claim 1, further comprising:

5   performing frame averaging.

19.   The method of claim 1, further comprising:

performing frame sharpening.

20.   A method for stabilizing a sequence of frames, comprising:

calculating a first position of a point of interest in a first frame;

10   identifying estimated positions of points of interest in a second frame and a

third frame that correspond to the point of interest in the first frame;

identifying tracked positions of points of interest in the second frame and

the third frame based on the estimated positions of the point of interest, wherein

the tracked positions comprise a second position for the point of interest in the

15   second frame and a third position for the point of interest in the third frame;

plotting the first position, the second position, and the third position on an

X,Y coordinate graph; and

connecting the first position to the third position on the X,Y coordinate

graph, wherein ideal positions of the point of interest in the first frame, second

20   frame, and third frame lie on the connection.

21.   The method of claim 20, further comprising:

-60-

performing affine transformation to adjust each pixel in the second frame

and third frame based on the ideal positions.

22.   The method of claim 21, wherein performing affine transformation

further comprises:

5   determining values of coefficients representing rotation, scaling, shearing,

and/or translation information using the tracked positions and the ideal positions.

23.   The method of claim 22, further comprising:

applying the values of the coefficients to each pixel of the first frame to

obtain positions of each pixel in the second frame.

10   24.   The method of claim 20, further comprising:

determining whether to perform global tracking or matching to generate

estimated positions of points of interest.

25.   The method of claim 24, wherein the determination is based on

whether camera motion for the sequence of frames is fast or slow.

15   26.   A system, comprising:

a computer including a processor and a memory;

a sequence of frames stored in the memory;

a program stored in the memory of the computer, wherein the program is

executed by the processor of the computer to:

20   identify one or more features in a first frame in the sequence of frames;

calculate tracked positions for one or more features in each other frame in the sequence of frames based on the features in the first frame;

calculate ideal positions for the features in each other frame in the sequence of frames based on the tracked positions;

5   identify transformation information based on the tracked positions and the calculated positions; and

transform each other frame in the sequence of frames by adjusting pixels in each other frame based on the transformation information.

27.   The system of claim 26, further comprising:

10   a video camera for recording the sequence of frames.

28.   The system of claim 27, wherein execution of the program further comprises:

determining whether the sequence of frames was recorded with fast camera motion or slow camera motion.

15   29.   The system of claim 28, wherein execution of the program further comprises:

when it is determined that the sequence of frames was recorded with fast camera motion, performing matching to calculate tracked positions for each feature in a second frame in the sequence of frames.

20   30.   The system of claim 29, wherein execution of the program further comprises:

identifying one or more features in the second frame; and

matching the one or more features in the first frame to the one or more features in the second frame.

31.   The system of claim 28, wherein execution of the program further

5   comprises:

when it is determined that the sequence of frames was recorded with slow camera motion, performing global tracking to calculate estimated positions for each of the one or more features in the second frame.

32.   The system of claim 31, wherein execution of the program further

10   comprises:

selecting a first feature in the first frame; and

searching a portion of the second frame to find a feature that corresponds to the selected first feature in the first frame.

33.   The system of claim 27, wherein execution of the program further

15   comprises:

plotting the tracked positions in an X, Y coordinate graph; and

drawing a motion trajectory by connecting a first one of the plotted tracked positions with a last one of the plotted tracked positions.

34.   The system of claim 33,

20   wherein the motion trajectory is linear.

35. The system of claim 33, wherein the motion trajectory is non-linear.

36. The method of claim 33, wherein the ideal positions comprise positions on the motion trajectory.

37. The system of claim 27, wherein execution of the program further comprises:

performing affine transformation using the tracked positions and the ideal positions.

38. The system of claim 37, wherein execution of the program further comprises:

determining values of coefficients representing rotation, scaling, shearing, and/or translation information using the tracked positions and the ideal positions.

39. The system of claim 38, wherein execution of the program further comprises:

applying the values of the coefficients to each pixel of the first frame to obtain positions of each pixel in a second frame.

40. The system of claim 38, wherein execution of the program further comprises:

performing frame averaging; and

performing frame sharpening.

41. A system, comprising:

a camera;

a sequence of frames captured by the camera;

a computer with a processor and a memory, wherein a sequence of frames is stored in the memory of the computer; and

5   means for performing local tracking to obtain tracked positions for a feature in multiple frames of the sequence of frames;

means for calculating ideal positions for the feature in each of the multiple frames;

means for identifying transformation information based on the tracked

10   positions and the ideal positions for each feature in the one or more features; and

means for transforming each other frame by adjusting pixels in each other frame based on the transformation information.

42.   The system of claim 41, further comprising:

means for, when it is determined that the sequence of frames was recorded

15   with fast camera motion, performing matching to identify estimated positions for features in a frame.

43.   The system of claim 41, further comprising:

means for, when it is determined that the sequence of frames was recorded with slow camera motion, performing global tracking to identify estimated

20   positions for features in a frame.

44.   The system of claim 41, further comprising:

means for calculating estimated positions for features in a frame;

means for calculating tracked positions based on the estimated positions; and

means for drawing a motion trajectory based on the tracked positions.

45.   The system of claim 41, wherein transforming information comprises rotation, scaling, shearing, and/or translation information for each pixel of a frame.

46.   The system of claim 41, wherein calculating ideal positions further comprises:

means for plotting the tracked positions in an X, Y coordinate graph; and

means for drawing a motion trajectory by connecting a first one of the plotted tracked positions with a last one of the plotted tracked positions.

47.   The system of claim 46, wherein the ideal positions comprise positions on the motion trajectory.

48.   A computer readable storage medium encoded with software instructions, wherein execution of the instructions comprises:

identifying one or more features in a first frame in the sequence of frames;

calculating tracked positions for one or more features in each other frame in the sequence of frames based on the features in the first frame;

calculating ideal positions for the features in each other frame in the sequence of frames based on the tracked positions;

identifying transformation information based on the tracked positions and the calculated positions; and

transforming each other frame in the sequence of frames by adjusting pixels in each other frame based on the transformation information.

5   49.   The computer readable storage medium of claim 48, wherein execution of the instructions further comprises:

determining whether the sequence of frames was recorded with fast camera motion or slow camera motion.

50.   The computer readable storage medium of claim 49, wherein
10   execution of the instructions further comprises:

when it is determined that the sequence of frames was recorded with fast camera motion, performing matching to calculate estimated positions for each feature in a second frame in the sequence of frames.

51.   The computer readable storage medium of claim 50, wherein
15   execution of the instructions to perform matching further comprises:

identifying one or more features in a second frame in the sequence of frames; and

matching the features in the first frame to the features in the second frame.

52.   The computer readable storage medium of claim 49, wherein
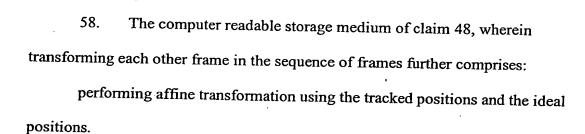20   execution of the instructions further comprises:

when it is determined that the video segment was recorded with slow camera motion, performing global tracking to calculate estimated positions for each feature in a second frame in the sequence of frames.

53.   The computer readable storage medium of claim 52, wherein

5   execution of the instructions to perform global tracking further comprises:

selecting a first feature in the first frame; and

searching a portion of the second frame to find a feature that corresponds to the selected first feature in the first frame.

54.   The computer readable storage medium of claim 48, wherein

10   calculating tracked positions comprises performing local tracking.

55.   The computer readable storage medium of claim 48, wherein execution of the instructions to calculate ideal positions further comprises:

plotting the tracked positions in an X, Y coordinate graph; and

drawing a motion trajectory by connecting a first one of the plotted tracked

15   positions with a last one of the plotted tracked positions.

56.   The computer readable storage medium of claim 55, wherein the ideal positions comprise positions on the motion trajectory.

57.   The computer readable storage medium of claim 48, wherein transformation information comprises rotation, scaling, shearing, and/or translation

20   information for each pixel of each other frame in the sequence of frames.

58.   The computer readable storage medium of claim 48, wherein transforming each other frame in the sequence of frames further comprises:

performing affine transformation using the tracked positions and the ideal positions.

5   59.   The computer readable storage medium of claim 58, wherein performing affine transformation further comprises:

determining values of coefficients representing rotation, scaling, shearing, and/or translation information using the tracked positions and the ideal positions.

60.   The computer readable storage medium of claim 48, further
10   comprising:

applying the values of the coefficients to each pixel of the first frame to obtain positions of each pixel in a second frame.